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What's happening at San Dimas?

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CATALOGING PREP

By
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Fire swept the 17,000-acre San Dimas Experimental Forest in southern California July 20, 1960. Immediately after the fire, the Forest Service, California's Division of Forestry and Department of Water Resources, and Los Angeles County's Fire Department and Flood Control District joined forces in an emergency research program. This program is testing "first aid" treatments aimed at reducing the flood and erosion damage that usually follows fire in southern California's steep, unstable, chaparral-covered mountains. Tests included large contour terraces, grass seeding, channel check dams, and contour row plantings of barley. The long-term water yield studies were begun anew. Now, 18 months and several storms after the fire, here's how things look.

COVER REESTABLISHMENT

To date, the perennial and annual grasses aerially sown in the small watersheds have had no noticeable effect on watershed performance. Because of the weather pattern, the first sowing, in the fall of 1960, resulted in less than 5 percent ground cover. Rains were deficient and poorly distributed that winter. The second sowing, in 1961, did not produce grass seedlings until after the February 1962 rains. By March, after nearly 26 inches of rain, the annual grass began to take off. The perennials had not yet responded.

Only in 875-acre Monroe Canyon is there a substantial annual grass cover. This canyon was the first area seeded in the 1960 fall season and benefited by early fall rains. The second-year crop is now well established. On north-facing deep soils, there is a lush stand 12 to 18 inches high. South-facing deep soils have a good, but less dense cover. Shallow soils, which occupy 700 acres, have a thinner cover augmented by native herbaceous and brush vegetation.

LARGE WATERSHED PERFORMANCE

Fire's aftermath was dramatically demonstrated in Monroe Canyon and adjoining 740-acre Volfe Canyon. Here is the record for two comparable storms--one before the fire, in 1954, and the other after the fire, in 1961:

STORM DATE	Feb. 13, 1954	Dec. 1, 1961
RAINFALL		
Season total before storm	17.0 in.	6.3 in.
Storm total before peak intensity	3.6 in.	2.6 in.
Maximum intensity during storm		
20-minute	0.9 in.	1.2 in.
60-minute	0.7 in.	0.7 in.
FLOOD PEAK FLOW		
Monroe Canyon	4.4 c.f.s.	880 c.f.s.1/
Volfe Canyon	0.8 c.f.s.	660 c.f.s.1/

1/ Gaging station overwhelmed; estimated from observations made during storm.

Peak flows from the burned watersheds were about 200 to 800 times greater than from the similar storm before the fire. The contrast in debris production was as great. During the 1954 storm, streamflow was regulated, clear, and prolonged. In 1961, most of the flow came in a few minutes and was heavily laden with silt, sand, and boulders. The Monroe streamgaging station was pounded and overwhelmed; after the storm it looked as though it had been hit by an avalanche.

Monroe Canyon, from which 40 acres of riparian growth had been removed 18 months before the fire, showed more evidence of large rock and boulder movement than Volfe. One boulder measuring 7 feet by 4 feet moved more than 300 feet. The channel in Monroe is now loaded with large rock and rubble. The material in Volfe is smaller. It may be that the riparian growth in Volfe screened out the larger material and reduced the flood flow's carrying power.

The gaging flumes in both watersheds are now buried in debris 6 to 8 feet deep. This channel filling extends for a mile above each station on a steady 8 to 9 percent grade.

COMPARISON OF FIRST AID TREATMENTS IN SMALL WATERSHEDS

Grass Sowing

Sown grasses, both annual and perennial, have not yet affected watershed performance. These are results following a year of severe drought. General conclusions concerning the effects of this emergency treatment on watershed performance cannot be drawn from this limited experience. Now, after the February 1962 rainfall, the annual grasses are beginning to grow. We expect them to moderate subsequent storm flow.

Contour Barley Plantings

Row plantings of barley on close contours have so far been very effective. Germination was excellent despite cold weather and low rainfall the winter of 1960-61. The stand was 2 inches high in less than two weeks and formed a substantial barrier to overland flow and sediment transport. Its rapid growth continued, and by spring barley-stalk contour "fences" were firmly established. A good seed crop produced an excellent volunteer stand the winter of 1961-62. The old stalks, plus the new crop, continue to protect against raindrop impact, soil detachment, and overland flow. Thus far the barley planted watersheds have produced the least sediment transport during prolonged storms and during high intensity periods.

Terraces

Terrace performance is less promising, though at first it looked good. Terraced watersheds produced almost no sediment and little streamflow during the small storms of 1960-61 and the first storm of the next rainy season. In subsequent storms, however, failures have occurred in every terraced watershed except those in which barley was also planted. During the second storm of 1961-62, failures occurred when moderately high intensity rainfall exceeded the infiltration and storage capacity of the terraces. In subsequent storms, additional failures occurred immediately after the peak rainfall intensities.

Individual terrace basins failed when the outside berm softened and settled below the level of the drainage system. Once the berms overtopped, large gullies were cut within a few minutes, draining the broken basins and those adjacent. Frequently this large load of water was dumped into the next terrace below, causing a chain raction of failures. This in turn produced relatively high and flashy peak flows with heavy sediment discharges from the terraced watersheds.

Channel Check Dams

Channel checks built of soil cement were designed to stabilize the channel and reduce further undercutting of side slopes. Until these small dams filled, during the second 1961-62 storm, flows from the channel-check watersheds were low and carried very little suspended sediment. After the check dams filled, storm flows were relatively high and heavily laden with

sediment, sand, and small gravel. However, there has been less rock and boulder movement than in watersheds without checks.

Observed differences in treatment response have been associated with the intensity of rainfall rather than with the total size of the storm. Most sediment transport and debris movement has occurred within minutes after bursts of high intensity rainfall. When intensities exceeded 1/2-inch per hour, large peak flows and debris loads usually followed.

SUMMARY

1. Eighteen months after the fire, and 15 months after the first seeding, sown grass is still not effective in improving watershed performance. Drought conditions during the first growing season were not favorable for grass growth. It is apparent that because of the great variation in the weather pattern in southern California, generalizations on the results of emergency revegetation cannot be drawn from a single year's experience.

After two months of heavy rain in 1962, however, the annual grasses are finally beginning to take off. We expect them to moderate storm flow in coming months.

2. The burned watersheds can take large quantities of rain in terms of total volume. Rainfall intensity is the real "killer." High peak flows and heavy sediment and debris loads are associated with intensities greater than 1/2-inch per hour.

3. At this writing, barley contour-row plantings (alone and in combination with terraces) seem to be our best first-aid treatment. Terraces, when unaided by barley plantings, have failed and at this time do not appear promising in conditions of steep topography, unstable soils and high intensity storms found in the San Gabriel Mountains.

At San Dimas Experimental Forest the first sizable winter storms brought out some differences in emergency measures being studied as possible first aid for burned watersheds . . .

. . . Barley planted on contour (above) has done a good job of reducing soil movement.

. . . Inexpensive check dams (bottom left) withstood overtopping flows and reduced downcutting of channels.

. . . Large terraces on contour were overtopped and washed out (bottom right) except where slopes were protected by barley plantings.

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Special recognition is due these agencies and the California Department of Water Resources for assistance with emergency rehabilitation work after a wildfire in July 1960. Their cooperation made it possible to restore experimental facilities and start emergency research on methods of managing chaparral watersheds for more effective control of fires, floods and erosion, and water yield.

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